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United States Department of Agriculture.

BUREAU OF SOILS—CIRCULAR No. 13.

MILTON WHITNEY, *Chief of Bureau.*

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., February 25, 1904.

SIR: I have the honor to transmit herewith a manuscript, "The Work of the Bureau of Soils." This is intended for distribution at the Louisiana Purchase Exposition at St. Louis, and contains a condensed account of the work of this Bureau, with particular attention to its practical side. I would respectfully recommend that this be published as Circular No. 13 of this Bureau.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

THE WORK OF THE BUREAU OF SOILS.

In 1894 a division was created in the Weather Bureau "for the study of climatology in its relation to soils." At the time of its creation it had a chief of division, 4 soil experts, 3 clerks, and 2 laborers. On July 1, 1901, the Division was made an independent Bureau of the Department of Agriculture, and on July 1, 1903, its force consisted of a chief of bureau, chief clerk, 80 scientists and soil experts, 12 tobacco experts, and 28 clerks. Thus in eight years its personnel has increased from 10 to 122, or 12 times. Great as this increase has been, however, the Bureau's force is not adequate to meet half the demands made on it for investigations along its special lines.

It was not a new problem which the Bureau undertook to solve. The study of soils had been carried on by State organizations and foreign governments for nearly a century. Many attempts had been made to classify soils according to the laboratory results obtained in investigations of the chemical composition or the physical properties of the soil, but the problem proved too intricate for solution by laboratory methods alone. Many soil maps had been prepared, but they were based upon the geology of the area and were of little or no

use to the farmer. At the time the new Division began its work the futility of former methods of soil classification was beginning to be realized.

The original object in the organization of the Division of Soils was to study the relation of the climatic conditions of moisture and temperature under the surface of the ground to the local distribution of crops. This work was largely of a technical nature, and involved questions of soil conditions and plant growth with which soil investigators all over the world had long wrestled. While the Bureau of Soils is now, and has been from the first, working on these intricate problems, it promptly undertook work of more immediate benefit to the farmer. It saw that differences in the commercial value of land could be detected in the field from the character of the soil and its relation to crops. It believed that a classification of soils with reference to texture and structure, physiographic position, and crop values could be made and the areas of different soils outlined in colors on maps, and that this would enable a farmer or a prospective purchaser of land in the area to determine at a glance the quality and farming value of any tract of land. Moreover, by carrying into a new area the knowledge of soils and crops gained in former surveys, it could enable the farmers of the new area to profit by the experience of those in the areas previously surveyed. This has proved especially valuable in the case of special industries, such as tobacco, fruit raising, trucking, sugar beets, etc.

So prompt were the farmers to recognize the value of this survey work, and so great was the demand for surveys all over the country, that the Bureau was compelled, contrary to its previous plans and almost against its will, to abandon certain lines of more technical investigation and devote a large part of its energy to the soil survey work. This work is now being carried on by 20 field parties working in as many States or Territories. A soil party consists generally of two men, who are equipped with a compass, an odometer for measuring distances, sometimes with a plane table to make or correct a base map, and with a soil auger to take samples usually to a depth of 3 feet in humid regions and 6 feet in arid regions, but by means of extensions capable of taking borings to a depth of 18 feet. Parties in arid regions where alkali is likely to be encountered are equipped with a portable outfit of instruments and chemicals for determining in the field the total salt content of the soil, and the chemical composition of the alkali salts and irrigation waters. Selecting some town in the area to be surveyed for its temporary headquarters, the party hires a horse and buggy and carries on its work about as follows: Driving along a road, one or both of the men go out into the fields for a distance of half a mile, more or less, according to the character of the country and the position of other roads, and take frequent borings.

They examine the material carefully, noting the texture, whether sand, silt, or clay, the changes which take place at varying depths, the presence of gravel, the drainage conditions, and the character of the crops or native vegetation. If the borings show a sandy loam to a depth of 6 or 8 inches, and below this a loam grading into a clay at a depth of 24 to 30 inches, the soil would probably be called a sandy loam or a loam, according to the general character of the material as a whole. If these conditions were found to prevail over a considerable area, this sandy loam, or loam, would be recognized as a type and a name given it. Moving forward with their work, if the party found that the material changed, either in the surface soil or the subsoil, sufficiently to influence plant growth, the character of this change would be noted; and if it were of sufficient importance and covered an appreciable area, a new type would be established. The boundary between the two types would then be traced out, the character of the vegetation or crops, and the physiography of the country frequently being an important aid in this work.

Separate samples of the soil and of the subsoil are sent in to the Bureau's laboratories from a number of borings in each of the soils, the number depending upon the extent and importance of the area or the agricultural problems presented therein. These samples are examined in the laboratories, a mechanical analysis is made to show the grade of material composing the soil, and such chemical work is done as experience may indicate will be of probable value in explaining the conditions encountered in the area.

During the months that the parties are in the field they are careful to observe the character and yield of the crops. They are instructed to obtain all possible information from the farmers as to the methods of cultivation, the relation of the soils to drought and to drainage, and in general to acquire the fullest knowledge of the farming conditions in the area. It is clearly recognized that the climate has much to do with the relation of soils to crops, and for this reason a brief statement of the climatic conditions is always given in the reports. It is also recognized that certain economic conditions, frequently local, have a controlling influence upon the relative crop values of soils. The chief among these are the questions of convenience and cost of transportation, the market conditions, and the conditions with respect to labor. These matters are brought out as clearly as possible in the reports of the work.

An idea of the growth of the soil-survey work may be gained by comparing the figures for the year 1900 with those for the year 1903. At the close of the fiscal year ended June 30, 1900, the Bureau had mapped 3,486 square miles, or 2,231,040 acres. At the close of the calendar year ended December 31, 1903 (a period of three and one-half years), it had mapped 60,412 square miles, or 38,663,680 acres.

This vast area is distributed among the different States and Territories as follows:

Location and size of areas surveyed and mapped by the Bureau of Soils up to December 31, 1903.

State or Territory.	Name of area.	Size of area.	
		Sq. miles.	*Acres.*
Alabama	Fort Payne	509	325,760
	Huntsville	506	323,840
	Mobile	461	295,040
	Perry County	762	487,680
Total for State		2,238	1,432,320
Arizona	Salt River Valley	449	287,360
	Solomonsville	108	69,120
	Yuma	99	63,360
Total for State		656	419,840
Arkansas	Miller County	626	400,640
	Stuttgart	251	160,640
Total for State		877	561,280
California	Fresno	628	401,920
	Hanford	216	138,240
	Imperial	1,084	693,760
	Indio	234	149,760
	Los Angeles	570	364,800
	Sacramento	515	329,600
	Salinas Valley	344	220,160
	San Gabriel	259	165,760
	San Jose	313	200,320
	Santa Ana	275	176,000
	Ventura	240	153,600
Total for State		4,678	2,993,920
Colorado	Lower Arkansas Valley	945	604,800
	San Luis Valley	628	401,920
Total for State		1,573	1,006,720
Connecticut	Connecticut Valley	505	323,200
Delaware	Dover	314	200,960
Florida	Gadsden County	548	350,720
Georgia	Cobb County	346	221,440
	Covington	225	144,000
	Fort Valley	186	119,040
Total for State		757	484,480
Idaho	Blackfoot	428	273,920
	Boise	399	255,360
	Lewiston	308	197,120
Total for State		1,135	726,400
Illinois	Clay County	460	294,400
	Clinton County	491	314,240
	Johnson County	339	216,960
	Knox County	717	458,880
	McLean County	1,159	741,760
	Sangamon County	866	554,240

Location and size of areas surveyed and mapped by the Bureau of Soils up to December 31, 1903—Continued.

State or Territory.	Name of area.	Size of area.	
		Sq. miles.	*Acres.*
Illinois	St. Clair County	650	416,000
	Tazewell County	645	412,800
	Winnebago County	526	336,640
Total for State		5,853	3,745,920
Indiana	Madison County	435	278,400
	Posey County	387	247,680
Total for State		822	526,080
Iowa	Cerro Gordo County	567	362,880
	Dubuque	440	281,600
	Story County	576	368,640
Total for State		1,583	1,013,120
Kansas	Parsons	398	254,720
	Russell	270	172,800
	Wichita	465	297,600
Total for State		1,133	725,120
Kentucky	Mason County	225	144,000
	Scott County	280	179,200
	Union County	361	231,040
Total for State		866	554,240
Louisiana	Acadia Parish	636	407,040
	Lake Charles	202	129,280
	New Orleans	410	262,400
	Ouachita	605	387,200
Total for State		1,853	1,185,920
Maryland	Calvert County	217	138,880
	Cecil County	376	240,640
	Harford County	418	267,520
	Kent County	293	187,520
	Prince George County	480	307,200
	St. Mary County	363	232,320
	Worcester County	463	296,320
Total for State		2,610	1,670,400
Massachusetts	Connecticut Valley	809	517,760
Michigan	Allegan County	828	529,920
	Pontiac	307	196,480
Total for State		1,135	726,400
Minnesota	Marshall	233	149,120
Mississippi	McNeill	198	126,720
	Smedes	463	296,320
	Yazoo	656	419,840
Total for State		1,317	842,880
Missouri	Howell County	919	588,160
	Shelby County	511	327,040
Total for State		1,430	915,200
Montana	Billings	107	68,480

Location and size of areas surveyed and mapped by the Bureau of Soils up to December 31, 1903—Continued.

State or Territory.	Name of area.	Size of area.	
		Sq. miles.	*Acres.*
Nebraska	Grand Island	446	285,440
	Stanton	323	206,720
Total for State		769	492,160
New Jersey	Salem	493	315,520
	Trenton	810	518,400
Total for State		1,303	833,920
New Mexico	Carlsbad	80	51,200
	Roswell	49	31,360
Total for State		129	82,560
New York	Bigflats	223	142,720
	Long Island	845	540,800
	Lyons	515	329,600
	Syracuse	416	266,240
	Westfield	260	166,400
Total for State		2,259	1,445,760
North Carolina	Alamance County	365	233,600
	Asheville	497	318,080
	Cary	63	40,320
	Craven	897	574,080
	Hickory	988	632,320
	Mount Mitchell	497	318,080
	Parmele	236	151,040
	Raleigh to Newbern	765	489,600
	Saluda	190	121,600
	Statesville	784	501,760
Total for State		5,282	3,380,480
North Dakota	Fargo	406	259,840
	Grand Forks	314	200,960
	Jamestown	496	317,440
Total for State		1,216	778,240
Ohio	Ashtabula	340	217,600
	Columbus	472	302,080
	Montgomery	480	307,200
	Toledo	403	257,920
Total for State		1,695	1,084,800
Oregon	Baker City	158	101,120
	Salem	284	181,760
Total for State		442	282,880
Pennsylvania	Lancaster	269	172,160
	Lebanon	669	428,160
	Lockhaven	278	177,920
Total for State		1,216	778,240
Porto Rico	Arecibo to Ponce	330	211,200
South Carolina	Abbeville	1,006	643,840
	Campobello	515	329,600
	Darlington	599	383,360
	Orangeburg	230	147,200
Total for State		2,350	1,504,000

Location and size of areas surveyed and mapped by the Bureau of Soils up to December 31, 1903—Continued.

State or Territory.	Name of area.	Size of area.	
		Sq. miles.	*Acres.*
South Dakota	Brookings	484	309,760
Tennessee	Clarksville	547	350,080
	Davidson County	501	320,640
	Pikeville	440	281,600
Total for State		1,488	952,320
Texas	Brazoria	845	540,800
	Jacksonville	100	64,000
	Lufkin	99	63,360
	Nacogdoches	97	62,080
	Paris	548	350,720
	Vernon	277	177,280
	Willis	215	137,600
	Woodville	100	64,000
Total for State		2,281	1,459,840
Utah	Provo	373	238,720
	Salt Lake Valley	249	159,360
	Sevier Valley	235	150,400
	Weber County	310	198,400
Total for State		1,167	746,880
Virginia	Albemarle	1,410	902,400
	Bedford	632	404,480
	Leesburg	419	268,160
	Norfolk	303	193,920
	Prince Edward	430	275,200
Total for State		3,194	2,044,160
Washington	Walla Walla	201	128,640
	Yakima	309	197,760
Total for State		510	326,400
Wisconsin	Janesville	451	288,640
	Viroqua	504	322,560
Total for State		955	611,200
Wyoming	Laramie	309	197,760
Grand total		60,411	38,663,040

ADVANTAGES OF THE SOIL SURVEY WORK.

From its surveys the Bureau is steadily accumulating a great mass of information about the various soils found in different parts of the country. This will soon enable it accurately to state what soils are best adapted to the production of different kinds of cotton, tobacco, corn, wheat, and other staple crops. In many localities crops are being grown on soils which are not adapted to them. Thus, in many States attempts are being made to grow wheat on soils so sandy that only a very low yield can be obtained. In other sections of the country attempts are being made to grow early truck on cold, wet clay

soils, which are wholly unsuited to such crops. In some of our tobacco-growing States the farmers are growing an inferior leaf, selling for a low price, on lands which are really adapted to special kinds of tobacco, bringing much higher prices. The influence of soil upon the quality of tobacco is so marked that a fine bright tobacco land may be separated by a few feet from one which will produce only a coarse, heavy, inferior leaf. In the mountain fruit districts of our Southern States certain soils are not only adapted to certain fruits, as apples, peaches, grapes, etc., but distinct soils are recognized as best adapted to single varieties of these fruits.

An example is the mountain soil (named by the Bureau Porters black loam) which in Virginia is called "Pippin land," because the celebrated Albemarle Pippin does better on it than on any other soil. With the present system of classification and knowledge of these mountain soils and their adaptation to different varieties of fruits, the Bureau's soil survey parties can enter any of the mountain areas of our Eastern States and quickly and accurately distinguish the good fruit lands from the poor. To one who wishes to engage in the fruit-growing industry in these fertile mountain regions this information is an insurance against loss from purchasing poor fruit soil, and means a great saving of time and money by rendering unnecessary any experiments in planting different varieties on different soils.

The investigation of important agricultural industries which have been developed on soils with certain characteristics enables the Bureau of Soils to safely recommend the introduction of such industries in other localities where similar soils and climatic conditions prevail. An example of this is the mountain peach industry of western Maryland. It was found that peaches of superior quality and flavor could be grown on some of the stony foothill soils of that section which were worthless for general farming purposes. The peaches grown here ripen in season to be placed on the market at a time when the supply from other localities is small and prices correspondingly high. Upon extending the soil survey work into other parts of Maryland and into the adjoining State of Virginia the Bureau of Soils was able to recommend the introduction of the mountain peach industry in a number of places where conditions of soil and climate similar to those of western Maryland were found.

Another example of the value of the Bureau's recommendations is furnished by the soil survey in the Pecos Valley, New Mexico. In the report on this survey a strong recommendation was made to increase the amount of alfalfa grown and to develop the stock-raising industry. During the few years which have elapsed since that recommendation was made attempts at growing fruits and field crops to which the soils and climate were not suited have been largely abandoned, and in their place a profitable stock-raising industry has been developed.

The soil survey work is of considerable value in furnishing instruction as to the cultivation of different kinds of soils in various parts of the country. That sandy soils and heavy clay soils require widely different methods of cultivation has long been known, but the great importance of this has been most clearly brought out by the comparative methods of the soil survey. For example, the proper cultivation of the sandy soils in the cotton-growing districts of the South Atlantic States is well understood, but the productive value of the clay soils is so little appreciated that they have never been given the importance which they deserve. These clay soils would be more productive than the sandy soils if they were properly cultivated. By calling to the attention of the farmers in these districts the profitable yields obtained from similar lands in other parts of the country, and by showing them that the crop yields on those heavy soils would give them a larger net profit, even though the cost of cultivation be greater than on the sandy soils, the Bureau expects to bring about the cultivation of productive soils which have remained practically untouched.

As an illustration of the monetary value of the Bureau's work in establishing the relation between soils and crops, it may be stated that the soils of the Connecticut Valley, which the Bureau declared were adapted to the growing of Sumatra wrapper tobacco, have increased in value more than threefold. The successful termination of the Bureau's experiments in growing Cuban filler tobacco will double or treble the price of certain soil types in our Southern States. Other instances of the increase of land values through the discovery of the adaptation of certain soils to special crops may be cited. The trucking soils of the Atlantic seaboard have increased of late years from a nominal value of $5 per acre to $200 or more per acre. The rice lands of Louisiana have increased in value from $5 to $50 per acre. The Florida soils, adapted to the growing of pineapples, have risen in value from practically nothing to over $500 per acre.

Yet another advantage of the soil survey work is the accurate basis which it furnishes for further experimentation. The mapping of the different soils in the several States serves as a true guide for further experimental work, whether with methods of cultivation, or of crop rotation, or with different manures and fertilizers. So fully is the value of this work realized that some of the State organizations use the soil survey maps as a basis for locating their experimental farms.

In several instances the Bureau of Soils has rendered valuable service to would-be settlers in undeveloped sections of the country. The incorporation of companies to open up and to advertise large tracts of land sometimes leads to the exploitation of regions unsuited to agriculture. The agents of the Bureau have been called on from time to time to investigate these lands, and in some cases have discovered that they were of little or no value to intended settlers, either

because of the presence of alkali or because they were not adapted to the only crop suited to the area (as is the case with certain soils in the great wheat belt of the Northwest), and the publication of these facts has saved many home seekers from investing their all in ventures which were bound to prove unprofitable.

In all its work the Bureau of Soils aims at practical results. Its reports deal with everyday problems, and are written with as little use of technical terms as possible. It is not meant by this that the Bureau disregards the scientific side of the many problems with which it has to deal. It has two laboratories—one for chemical and one for physical analyses—in charge of experts of acknowledged ability. The few technical bulletins issued by the Bureau have attracted no little attention from investigators in this line of work. But the technical scientific work has been subordinated to the attainment of practical results.

TOBACCO INVESTIGATIONS.

The first soil survey made by the Bureau was in the Connecticut Valley during the summer of 1899. The object was primarily to study and map the different tobacco soils, but incidentally all the soils were surveyed. This survey, together with some investigations and comparisons previously made by the Bureau, led to the conviction that Sumatra cigar wrapper tobacco could be raised on some of the soils of the area which showed a remarkable resemblance to the tobacco soils of the island of Sumatra. While the soils were nearly identical, however, the climatic conditions were widely different, and in order to grow a wrapper leaf similar to the Sumatra tobacco, it was necessary to create by artificial means a climate similar to the tropical climate of Sumatra. This was done by erecting "shade," a method which had been successfully employed in Florida for several seasons. This "shade" consists of a framework of wood, about 9 feet high, over the top and sides of which a cheese-cloth covering is fastened. These tents protect the plant from wind, hail, and insects; prevent rapid evaporation from the soil and from the leaves, check radiation of heat, and in general maintain a tropical condition under which the plants make large and rapid growth.

In 1900 an experimental tract of one-third of an acre of Sumatra tobacco was grown under shade. The product was so fine that in 1901 over 41 acres were planted, and in 1902 this was increased to 700 acres. The yield per acre of the 1901 crop was about 14,000 pounds, and the average selling price was $1.20 per pound. The 1902 crop has not yet been sold, but using the figures of 1901 as a basis for comparisons we can safely say that the 700 acres under shade produced about 1,000,000 pounds of cured tobacco, or 800,800 pounds of baled tobacco, exclusive of trash. The total value of the baled tobacco at

$1.20 per pound would be $960,960. During the season of 1903 about 700 acres of shaded tobacco were grown in the Connecticut Valley. The industry is now established on a sound basis and the work of the Bureau has been discontinued in that locality.

The commercial value of this work can be appreciated from the fact that this country imports each year about $6,000,000 worth of "wrapper" tobacco from Sumatra. The imported article brings from $2.50 to $3 a pound, and even at that price is found cheaper than home-grown "selected" wrappers at 50 cents a pound. It is expected that the demand for this tobacco will be largely, if not entirely, met by the American growers within a few years. It is estimated that there has been invested in this industry in the Connecticut Valley, in the form of shade, barns, warehouses, etc., nearly $1,000,000.

Another tobacco for which American manufacturers spend large sums abroad is the Cuban "filler." This is used for high-grade cigars and is considered the finest tobacco grown for this purpose. It has a flavor and aroma not found in the present domestic tobaccos. The value of Cuban filler imported in 1903 was over $10,000,000. The Bureau is now carrying on extensive investigations and experiments to determine whether a Cuban filler tobacco of superior quality can be grown in this country. Trial crops are being grown in Ohio, South Carolina, Alabama, and Texas, and while the results thus far obtained do not justify the positive statement that a Cuban filler tobacco equal to the imported article can be grown in those States, they are so encouraging that the Bureau believes it will be as successful in establishing this industry as it was in the case of the Sumatra wrapper tobacco.

Another important line of tobacco investigation in which the Bureau is engaged is that of curing and fermenting. Up to a few years ago all the tobacco grown in the Northern and Western States was "case" fermented—that is, the tobacco was packed in wooden boxes holding about 300 pounds each and stored in a warehouse for eight or nine months. The whole process of fermentation by this method was largely one of chance. It was not controlled and the temperature was not taken to note the progress of the fermentation, so that in some boxes it was excessive and in other boxes it was deficient. For this method was substituted the "bulk" fermentation which had been practiced successfully in Sumatra and Florida. By this method the tobacco is built up on the warehouse floor into large piles which are "broken down" and rebuilt whenever the temperature gets too high and the fermentation goes on too rapidly. A demonstration of the bulk method of fermentation is being carried on under the direction of one of the Bureau's experts in the tobacco exhibit of the Agricultural Building.

Under the "case" method of fermentation much of the tobacco was lost by the ravages of a fungus called the "black rot." The "bulk" method of fermentation prevents the growth of this fungus and tobacco so fermented is seldom damaged. During the year 1901 there was fermented in Pennsylvania, under the supervision of the Bureau's experts, over 5,000,000 pounds of tobacco, of which 35 pounds was damaged by black rot. It is estimated that $500,000 annually has been saved to the Pennsylvania packers alone as a result of the Bureau's work. During the year 1902 4,200,000 pounds of tobacco was fermented in Ohio under the direction of the Bureau, with no loss from black rot.

RECLAMATION OF ALKALI LAND.

Another special problem is found in the alkali conditions of the arid West. The rise of alkali has been one of the most threatening and least understood of the problems confronting the irrigation farmer. There are areas in the West where land has been rendered unfit for crops after having been cultivated for over twenty years. Land which once sold for $300 an acre is now practically worthless. How to prevent the rise of alkali in areas not yet damaged and how to reclaim those which have been injured, is a question the answer to which is eagerly sought.

The presence of alkali is due primarily to the climatic conditions of the West. The soils of the Eastern States have had the salts which they originally contained washed or leached out by the annual rains. The soils of the arid regions of the West, not having undergone this leaching process in the same degree as the eastern soils, contain a large part of the salts which were present in the rocks from which the soils are derived. When the land is first irrigated the water dissolves the salts and carries them downward. With continued irrigation, however, the subsoil becomes filled with water, and unless there be an adequate underground water movement the water table of the locality rises. When it rises within 3 to 6 feet of the surface, the depth depending mainly on the texture of the soil, the capillary power of the soil grains and the organic matter in the soil draw the water to the surface, much as oil rises in a wick. Here it is evaporated and the salt content is left behind. This process soon results in an accumulation of alkali in the surface soil, and vegetation is injured or destroyed. Many attempts have been made to free land from alkali by the application of gypsum, stable manure, and other substances, or by washing out the salts by flooding the land and quickly draining the water off the surface. None of these has proved of any permanent benefit to the land.

After careful investigation the Bureau became convinced that the only way permanently to reclaim alkali land is by underdrainage and flooding. This conviction was strengthened when the Bureau's expert in alkali-land reclamation made a trip to Egypt and Algeria during the summer of 1902 and investigated the work being done there by English and French engineers. In the lower Nile Valley they are reclaiming land so salt that it contains 380 tons of salt per acre to a depth of 3 feet.

The reclamation of alkali land by underdrainage and flooding is purely a mechanical process. The drains carry off the underground water as fast as it rises, and thus break the connection between the water table and the soil surface. The flooding dissolves the salt in the layer of soil above the drains and carries it down and out through the drains. In order to demonstrate the efficiency of this method of reclamation, the Bureau of Soils is underdraining and flooding tracts of land near Salt Lake City, Utah; Fresno, Cal.; North Yakima, Wash., and Tempe, Ariz. The experiments on these tracts have been so successful that the Bureau regards it as proved beyond question that thorough underdrainage and flooding will reclaim the worst of alkali lands. The cost of reclamation ranges from $10 to $30 per acre.

It is difficult to realize the vast importance of this work to the arid regions of the West. Of the 74,000,000 acres of land in the West for which there is sufficient water for irrigation, over 9,000,000 acres contain an excess of alkali salts. The value of this land if freed from alkali would be over $600,000,000. It is estimated that land values in the immediate vicinity of Salt Lake City alone will be increased over $3,000,000 as a result of the Bureau's successful demonstration of alkali-land reclamation at that place.

SOIL MANAGEMENT.

Possibilities for improvement in agricultural methods or for the introduction of new crops in an area are constantly presenting themselves to the parties who make the soil surveys. The mere statement in the soil survey reports that certain methods should be adopted or certain crops be grown is not always enough to induce the farmers in the area to make a change in their practices. Practical field demonstration seems to be the best way of impressing these lessons upon the farming class.

A division of soil management has been organized to meet this demand for field demonstration of the practicability of the recommendations contained in the Bureau's reports. This is the newest branch of the Bureau's work, and has not yet been carried far enough to warrant any statements as to results.

O